

TRIGGER STRATEGY FOR GAMMA+JET CALIBRATION

$$(L = 2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1})$$

- **Level 1:** single isolated electron(gamma) trigger is OK.
ET threshold = 23 GeV.
- **HLT:** single isolated gamma rate is dominated by QCD di-jet events and is very high. ET threshold = 80 GeV.
We need a special trigger for gamma+jet events with $ET_{\text{gamma}} < 80 \text{ GeV}$.

Gamma+jet calibration trigger

Since this trigger is proposed for a single purpose of the gamma+jet calibration, it can directly implement most of the off-line selection algorithms.

Two groups of the off-line selections:

- 1) gamma isolation;
- 2) suppression of the initial and final state radiation (delta phi cut, no second jet etc.)

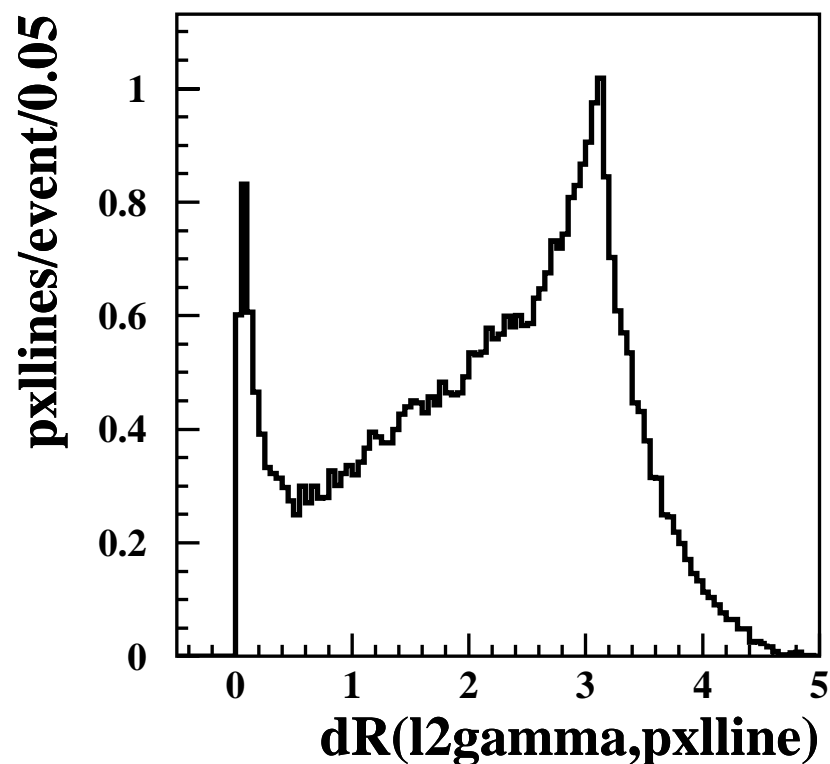
The second group cuts directly affect the jet energy scale and we should prefer to avoid using them at the trigger level.

The signal cross-section is high ($\sim 15\text{Hz}$ for $ET_{\text{gamma}} > 40\text{GeV}$ and $ET_{\text{Agamma}} < 1.5$), so we can use really hard isolation cuts with a signal efficiency of just few percent.

To estimate the background rates with photon isolation cuts I used the QCD jet event samples of the Egamma group (QCD di-jet events with soft preselection cuts at the particle level which are used by the Egamma group to calculate L1 and HLT rates).

Background events in the Pixel detector

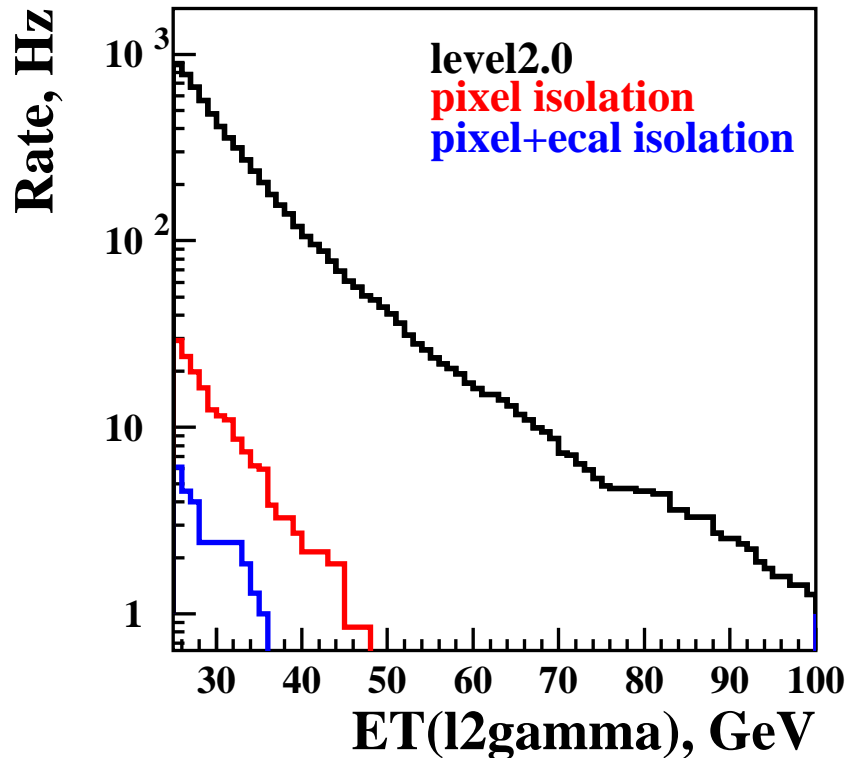
The primary vertex of an event is found as the vertex with the maximum sum of track PTs.
I look for pixel lines from the primary vertex around the level2.0 gamma direction.



Pixel line reconstruction becomes inefficient with $P_t < 1$ GeV and dies at ~ 0.8 GeV.

Asking no pixel lines inside the cone $R=1$ around gamma direction.

QCD background rates



1) level2.0 gamma(electron) with $\text{ETA} < 1.5$

2) no pixel line in the cone $R=1$ around the l2 gamma direction

3) Sum of ECAL digis with $\text{ET} > 100$ MeV in the region $0.07 < R < 0.5$ around the l2 gamma direction is required to be less than 1.2 GeV

Such gamma isolation cuts are expected to give signal/background > 1 (V.Konopliankov). Excessive trigger rates at low ET can be scaled down to affordable value.

Table 1: Event statistics

\hat{p}_T bin	PYTHIA	CMSIM	level2.0 $ \eta <1.5$ $E_T>30$	pixel isolation	ecal isolation	Hz/event
15-20	2670 K	100 K	0	0	0	1.73
20-30	1800 K	168 K	10	2	1	1.00
30-50	864 K	210 K	265	12	2	0.56
50-100	203 K	110 K	783	9	1	0.29
100up	22 K	20 K	144	1	0	0.16

CONCLUSION

1. We need a dedicated HLT for the gamma+jet calibration with gamma's $ET < 80$ GeV.
2. Such a trigger would be based mainly on hard photon isolation cuts with a few percent signal efficiency and thus of little use for general physics events.
3. The main trigger effect on the calibration is to limit the total number of calibration events by 2.5M for 3 months (2.5×10^6 s) if we can afford a 1 Hz rate to the tape for this calibration channel. Further off-line selection may be required (to suppress initial and final state radiation).